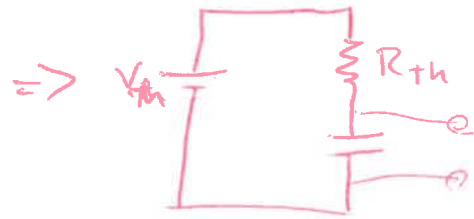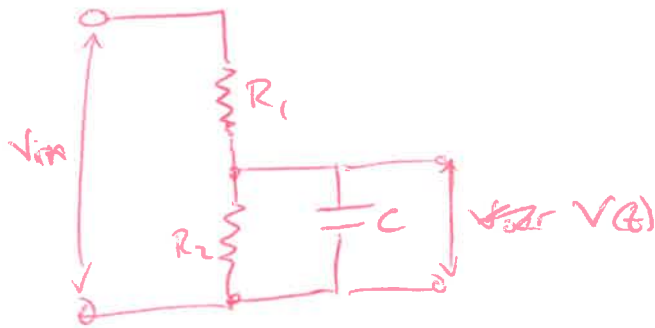# Problem 1.17

$$R_1 = R_2 = 10 \times 10^3 \, \Omega \quad C = 0.1 \times 10^{-6} \, F$$

$$V_{th} = \frac{R_2}{R_1 + R_2} V_{in} = \frac{V_{in}}{2}$$

$$R_{th} = \frac{R_1 R_2}{R_1 + R_2} = \frac{100k}{20k} = 5k = 5000 \, \Omega$$

$$RC = \frac{5 \times 10^3}{5000} \, \Omega \times 0.1 \times 10^{-6} \cdot ^{-3} = 0.5 \times 10^{-3} \, s$$

Problem 1.18

$$I = C \frac{dV}{dt}$$

$$I \int_0^t dt = C \int_0^{10V} dV$$

$$It = C \, 10V$$

$$ex. \quad 1 \times 10^{-3} \, t = 1 \times 10^{-6} \, 10$$
$$\phantom{ex. \quad 1 \times 10^{-3} \, t =} 1 \times 10^{-3}$$

$$t = 1 \times 10^{-2} \, s$$
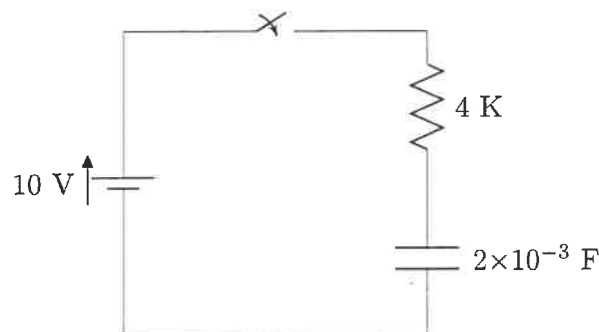
Name: _____KEY_____

Electronics for Scientists
RC Circuit

Instructions
Complete the following exercises to the best of your ability.

A RC circuit has a 10 volt battery, a switch, a 4 K resistor and a 2×10^{-3} F capacitor, as shown below.

$V_{resistor} = V_o e^{-t/RC}$

10 V   4 K

2×10^{-3} F

$V_{capacitor} = V_o (1 - e^{-t/RC})$

The capacitor is initially uncharged and the switch is closed at $t = 0$.

$V = IR$

1. What is the time constant for this circuit?

2. At a time of 1 time constant after the switch is closed, find the current through the circuit, the voltage across and resistor, and the voltage across the capacitor.

3. At a time of 2 time constant after the switch is closed, find the current through the circuit, the voltage across and resistor, and the voltage across the capacitor.

1) $\tau = RC = 4 \times 10^3 \, \Omega \times 2 \times 10^{-3} F = 8s$

2) $I = I_o e^{-t/RC}$ $I_o = \frac{V_o}{R} = \frac{10V}{4 \times 10^3 \Omega} = 2.5mA$ $I = 2.5mA \, e^{-1}$
$= 9.2 \times 10^{-4} A$

$V_{resistor} = V_o e^{-t/RC} = 10V e^{-1} = 3.68V$

$V_{capacitor} = V_o (1 - e^{-t/RC}) = 10V(1 - e^{-1}) = 6.32V$

3) $I_o e^{-2} = 3.4 \times 10^{-4} A$

$V_{res} = 10V e^{-2} = 1.35V$

$V_{cap} = 10V(1 - e^{-2}) = 8.65V$